

Claims

1 1. A method for processing a sequence of video
2 frames, said method comprising:

3 dynamically encoding said sequence of video frames
4 to produce a pseudo-constant bits per frame compressed
5 signal at a scene change within said sequence of video
6 frames, said dynamically encoding comprising:

7 detecting when a new scene occurs in the
8 sequence of video frames; and

9 responsive to said detecting, dynamically
10 determining a group of frequency domain pixel data
11 to be retained for a frame of the new scene.

1 2. The method of claim 1, wherein said dynamically
2 determining comprises determining a level of frequency
3 domain pixel data to be retained from multiple predefined
4 levels, and wherein said determining determines the level of
5 frequency domain pixel data to be retained for an initial
6 frame of the new scene.

1 3. The method of claim 2, wherein said level of
2 frequency data to be retained is associated with a frequency
3 constraining pattern, and said determining comprises
4 selecting a frequency constraining pattern to be employed
5 from a plurality of frequency constraining patterns
6 associated with said multiple predefined levels.

1 4. The method of claim 3, wherein said plurality of
2 frequency patterns comprise a common geometrical shape, and
3 wherein said common geometrical shape of said plurality of
4 frequency patterns can be one of a plurality of common
5 geometrical shapes.

1 5. The method of claim 3, wherein at least one most
2 significant frequency pixel is included by each of the
3 plurality of frequency constraining patterns.

1 6. The method of claim 1, wherein said dynamically
2 determining comprises determining said group of frequency
3 domain pixel data to be retained for said frame of the new
4 scene by evaluating picture difficulty of the new scene.

1 7. The method of claim 6, wherein said dynamically
2 determining further comprises ascertaining picture
3 difficulty indicators representative of picture difficulty
4 of the new scene, wherein said picture difficulty indicators
5 are ascertained by computing pixel-to-pixel differences in
6 at least some of horizontal, vertical, and diagonal
7 directions.

1 8. The method of claim 7, wherein said picture
2 difficulty indicators are ascertained by computing pixel-to-
3 pixel differences in each of said horizontal, vertical, and
4 diagonal directions.

1 9. The method of claim 7, wherein said ascertaining
2 comprises determining a maximum indicator for a frame
3 picture of a progressive video source or a field picture of
4 an interlaced video source, said maximum indicator being
5 determined by comparing said picture difficulty indicators
6 to each other.

1 10. The method of claim 7, wherein said ascertaining
2 comprises ascertaining picture difficulty indicators in
3 vertical and diagonal directions for both top and bottom
4 fields of a frame of an interlaced video source, and picture
5 difficulty indicators in vertical and diagonal directions
6 for the frame of the interlaced video source, and wherein
7 said ascertaining further comprises ascertaining field-based
8 indicators in vertical and diagonal directions by computing
9 a weighted summation of individual top and bottom field
10 indicators having a same direction, and wherein for each
11 vertical and diagonal direction, a picture difficulty
12 indicator is determined by ascertaining a minimum number
13 between a corresponding field-based indicator and a frame-
14 based indicator derived from the same frame of the
15 interlaced video source.

1 11. The method of claim 10, wherein said ascertaining
2 comprises selecting said picture difficulty indicators by
3 determining a maximum indicator of the ascertained vertical
4 and diagonal indicators, as well as a horizontal indicator.

1 12. The method of claim 9, wherein said ascertaining
2 further comprises mapping the maximum indicator to a level
3 of an n-level quantizer if the value of the maximum
4 indicator is between predefined thresholds, and mapping the
5 maximum indicator to a constant number if the indicator is
6 outside of said predefined thresholds.

1 13. The method of claim 12, further comprising
2 employing said mapping to identify an address of a frequency
3 pattern in a look-up table, said look-up table containing a
4 plurality of frequency patterns, and wherein said
5 determining comprises selecting one frequency pattern of
6 said plurality of frequency patterns.

1 14 The method of claim 13, wherein when the maximum
2 indicator has a large nominal value it is re-mapped into a
3 frequency pattern comprising a lesser number of frequency
4 coefficients than a number of coefficients of a frequency
5 pattern corresponding to when the maximum indicator has a
6 smaller nominal value.

1 15. The method of claim 14, wherein said plurality of
2 frequency patterns are indexed such that a population of one
3 frequency pattern is a subset of a population of a frequency
4 pattern with a lower index number.

1 16. The method of claim 14, wherein said determining
2 comprises comparing each frequency coefficient of a block
3 with respect to said selected frequency pattern, and if the
4 coefficient belongs to the frequency pattern, the
5 coefficient is retained as part of said group of frequency
6 domain pixel data.

1 17. The method of claim 1, wherein after a final frame
2 count, if the actual frame bits is smaller than the
3 difference of a predefined number and a guard band value,
4 the difference is computed and a number of zero bytes
5 according to this difference is added to the final picture
6 count to ensure said pseudo-constant bits per frame
7 compressed signal.

1 18. The method of claim 1, wherein said method is
2 implemented within an MPEG encoder.

1 19. The method of claim 1, wherein said dynamically
2 encoding further comprises encoding said frame of the new
3 scene as a intra-coded frame.

1 20. A method for processing a sequence of video
2 frames, said method comprising:

3 dynamically encoding said sequence of video
4 frames, said dynamically encoding comprising:

5 encoding multiple blocks of a first frame of
6 the sequence of video frames in intra-coded mode
7 using a first orientation for said intra-coded
8 blocks; and

9 encoding multiple blocks of a second frame of
10 the sequence of video frames in intra-coded mode
11 using a second orientation for said intra-coded
12 blocks, wherein said first orientation and said
13 second orientation are perpendicular.

1 21. The method of claim 20, wherein said first
2 orientation comprises a first diagonal orientation, and said
3 second orientation comprises a second diagonal orientation.

1 22. The method of claim 21, wherein said first frame
2 and said second frame comprise adjacent frames in said
3 sequence of video frames.

1 23. The method of claim 21, wherein said multiple
2 intra-coded blocks of said first frame are scattered
3 throughout said first frame, and wherein said multiple
4 intra-coded blocks of said second frame are scattered
5 throughout said second frame.

1 24. The method of claim 21, wherein said multiple
2 intra-coded blocks of said first frame are equally spaced
3 along a direction perpendicular to said first orientation of
4 said multiple intra-coded blocks, and wherein said multiple
5 intra-coded blocks of said second frame are equally spaced
6 along a direction perpendicular to said second orientation
7 of the multiple intra-coded blocks.

1 25. The method of claim 21, wherein said encoding said
2 multiple blocks of said first frame in intra-coded mode
3 using said first orientation comprises imposing different
4 sub-sampling rates on said multiple intra-coded blocks along
5 said first orientation, and wherein said encoding multiple
6 blocks of said second frame in intra-coded mode using said
7 second orientation comprises imposing different sub-sampling
8 rates on said multiple intra-coded blocks along said second
9 orientation.

1 26. The method of claim 21, wherein said sequence of
2 video frames comprises a plurality of even numbered frames
3 and a plurality of odd numbered frames, and wherein said
4 first frame comprises one frame of said plurality of even
5 numbered frames and said second frame comprises one frame of
6 said plurality of odd numbered frames, and wherein intra-
7 coded blocks of said plurality of even numbered frames move
8 along said first orientation in a direction opposite from
9 that of intra-coded blocks moving along said second
10 orientation within said plurality of odd numbered frames.

1 27. A system for processing a sequence of video
2 frames, said system comprising:

3 an encoder for dynamically encoding said sequence
4 of video frames to produce a pseudo-constant bits per
5 frame compressed signal at a scene change within said
6 sequence of video frames, said encoder comprising:

7 means for detecting when a new scene occurs
8 in the sequence of video frames; and

9 means for dynamically determining a group of
10 frequency domain pixel data to be retained for a
11 frame of the new scene responsive to said
12 detecting of the new scene.

1 28. The system of claim 27, wherein said means for
2 dynamically determining comprises means for determining a
3 level of frequency domain pixel data to be retained from
4 multiple predefined levels, and wherein said means for
5 determining determines the level of frequency domain pixel
6 data to be retained for an initial frame of the new scene.

1 29. The system of claim 28, wherein said level of
2 frequency data to be retained is associated with a frequency
3 constraining pattern, and said means for determining
4 comprises means for selecting a frequency constraining
5 pattern to be employed from a plurality of frequency
6 constraining patterns associated with said multiple
7 predefined levels.

1 30. The system of claim 29, wherein said plurality of
2 frequency patterns comprise a common geometrical shape, and
3 wherein said common geometrical shape of said plurality of
4 frequency patterns can be one of a plurality of common
5 geometrical shapes.

1 31. The system of claim 29, wherein at least one most
2 significant frequency pixel is included by each of the
3 plurality of frequency constraining patterns.

1 32. The system of claim 27, wherein said means for
2 dynamically determining comprises means for determining said
3 group of frequency domain pixel data to be retained for said
4 frame of the new scene by evaluating picture difficulty of
5 the new scene.

1 33. The system of claim 32, wherein said means for
2 dynamically determining further comprises means for
3 ascertaining picture difficulty indicators representative of
4 picture difficulty of the new scene, wherein said picture
5 difficulty indicators are ascertained by computing pixel-to-
6 pixel differences in at least some of horizontal, vertical,
7 and diagonal directions.

1 34. The system of claim 33, wherein said picture
2 difficulty indicators are ascertained by computing pixel-to-
3 pixel differences in each of said horizontal, vertical, and
4 diagonal directions.

1 35. The system of claim 33, wherein said means for
2 ascertaining comprises means for determining a maximum
3 indicator for a frame picture of a progressive video source
4 or a field picture of an interlaced video source, said
5 maximum indicator being determined by comparing said picture
6 difficulty indicators to each other.

1 36. The system of claim 33, wherein said means for
2 ascertaining comprises means for ascertaining picture
3 difficulty indicators in vertical and diagonal directions
4 for both top and bottom fields of a frame of an interlaced
5 video source, and picture difficulty indicators in vertical
6 and diagonal directions for the frame of the interlaced
7 video source, and wherein said means for ascertaining
8 further comprises means for ascertaining field-based
9 indicators in vertical and diagonal directions by computing
10 a weighted summation of individual top and bottom field
11 indicators having a same direction, and wherein for each
12 vertical and diagonal direction, a picture difficulty
13 indicator is determined by ascertaining a minimum number
14 between a corresponding field-based indicator and a frame-
15 based indicator derived from the same frame of the
16 interlaced video source.

1 37. The system of claim 36, wherein said means for
2 ascertaining comprises means for selecting said picture
3 difficulty indicators by determining a maximum indicator of
4 the ascertained vertical and diagonal indicators, as well as
5 a horizontal indicator.

1 38. The system of claim 35, wherein said means for
2 ascertaining further comprises means for mapping the maximum
3 indicator to a level of an n-level quantizer if the value of
4 the maximum indicator is between predefined thresholds, and
5 for mapping the maximum indicator to a constant number if
6 the indicator is outside of said predefined thresholds.

1 39. The system of claim 38, further comprising means
2 for employing said mapping to identify an address of a
3 frequency pattern in a look-up table, said look-up table
4 containing a plurality of frequency patterns, and wherein
5 said means for determining comprises means for selecting one
6 frequency pattern of said plurality of frequency patterns.

1 40. The system of claim 39, wherein when the maximum
2 indicator has a large nominal value it is re-mapped into a
3 frequency pattern comprising a lesser number of frequency
4 coefficients than a number of coefficients of a frequency
5 pattern corresponding to when the maximum indicator has a
6 smaller nominal value.

1 41. The system of claim 40, wherein said plurality of
2 frequency patterns are indexed such that a population of one
3 frequency pattern is a subset of a population of a frequency
4 pattern with a lower index number.

1 42. The system of claim 40, wherein said means for
2 determining comprises means for comparing each frequency
3 coefficient of a block with respect to said selected
4 frequency pattern, and if the coefficient belongs to the
5 frequency pattern, the coefficient is retained as part of
6 said group of frequency domain pixel data.

1 43. The system of claim 27, wherein after a final
2 frame count, if the actual frame bits is smaller than a
3 difference of a predefined number and a guard band value,
4 said system further comprises means for computing the
5 difference and adding a number of zero bytes according to
6 this difference to the final picture count to ensure said
7 pseudo-constant bits per frame compressed signal.

1 44. The system of claim 27, wherein said encoder
2 comprises an MPEG encoder.

1 45. The system of claim 27, wherein said means for
2 dynamically encoding further comprises means for encoding
3 said frame of the new scene as a intra-coded frame.

1 46. A system for processing a sequence of video
2 frames, said system comprising:

3 an encoder for dynamically encoding said sequence
4 of video frames, said encoder comprising:

5 means for encoding multiple blocks of a first
6 frame of the sequence of video frames in an intra-
7 coded mode using a first orientation for said
8 intra-coded blocks; and

9 means for encoding multiple blocks of a
10 second frame of the sequence of video frames in
11 intra-coded mode using a second orientation for
12 said intra-coded blocks, wherein said first
13 orientation and said second orientation are
14 perpendicular.

1 47. The system of claim 46, wherein said first
2 orientation comprises a first diagonal orientation, and said
3 second orientation comprises a second diagonal orientation.

1 48. The system of claim 47, wherein said first frame
2 and said second frame comprise adjacent frames in said
3 sequence of video frames.

1 49. The system of claim 47, wherein said multiple
2 intra-coded blocks of said first frame are scattered
3 throughout said first frame, and wherein said multiple
4 intra-coded blocks of said second frame are scattered
5 throughout said second frame.

1 50. The system of claim 47, wherein said multiple
2 intra-coded blocks of said first frame are equally spaced
3 along a direction perpendicular to said first orientation of
4 said multiple intra-coded blocks, and wherein said multiple
5 intra-coded blocks of said second frame are equally spaced
6 along a direction perpendicular to said second orientation
7 of the multiple intra-coded blocks.

1 51. The system of claim 47, wherein said means for
2 encoding said multiple blocks of said first frame in intra-
3 coded mode using said first orientation comprises means for
4 imposing different sub-sampling rates on said multiple
5 intra-coded blocks along said first orientation, and wherein
6 said means for encoding multiple blocks of said second frame
7 in intra-coded mode using said second orientation comprises
8 means for imposing different sub-sampling rates on said
9 multiple intra-coded blocks along said second orientation.

1 52. The system of claim 47, wherein said sequence of
2 video frames comprises a plurality of even numbered frames
3 and a plurality of odd numbered frames, and wherein said
4 first frame comprises one frame of said plurality of even
5 numbered frames and said second frame comprises one frame of
6 said plurality of odd numbered frames, wherein intra-coded
7 blocks of said even numbered frames move along said first
8 orientation in a direction opposite from that of intra-coded
9 blocks moving along said second orientation within said
10 plurality of odd numbered frames.

1 53. A system for processing a sequence of video
2 frames, said system comprising:

3 an encoder for dynamically encoding said sequence
4 of video frames to produce a pseudo-constant bits per
5 frame compressed signal at a scene change within said
6 sequence of video frames, said encoder comprising a
7 frequency domain data management unit, said frequency
8 domain data management unit comprising:

9 a scene-change detector for detecting when a
10 new scene occurs in the sequence of video frames;

11 a picture difficulty evaluator for evaluating
12 picture difficulty of the new scene;

13 a frequency classifier and constrainer for
14 dynamically determining a group of frequency
15 domain pixel data to be retained for a frame of
16 the new scene responsive to said detecting of the
17 new scene and complexity of the picture as
18 determined by said picture difficulty evaluator.

1 54. A system for processing a sequence of video
2 frames, said system comprising:

3 an encoder for dynamically encoding said sequence
4 of video frames, said encoder comprising:

5 an intra-updater unit for assigning which
6 blocks of a plurality of blocks of a frame are to
7 be intra-coded, wherein said intra-updater unit
8 facilitates:

9 encoding multiple blocks of a first
10 frame of the sequence of video frames in an
11 intra-coded mode using a first orientation
12 for said intra-coded blocks; and

13 encoding multiple blocks of a second
14 frame of the sequence of video frames in
15 intra-coded mode using a second orientation
16 for said intra-coded blocks, wherein said
17 first orientation and said second orientation
18 are perpendicular.

1 55. At least one program storage device readable by a
2 machine, tangibly embodying at least one program of
3 instructions executable by the machine to perform a method
4 for processing a sequence of video frames, said method
5 comprising:

6 dynamically encoding said sequence of video frames
7 to produce a pseudo-constant bits per frame compressed
8 signal at a scene change within said sequence of video
9 frames, said dynamically encoding comprising:

10 detecting when a new scene occurs in the
11 sequence of video frames; and

12 responsive to said detecting, dynamically
13 determining a group of frequency domain pixel data
14 to be retained for a frame of the new scene.

1 56. The at least one program storage device of claim
2 55, wherein said dynamically determining comprises
3 determining a level of frequency domain pixel data to be
4 retained from multiple predefined levels, and wherein said
5 determining determines the level of frequency domain pixel
6 data to be retained for an initial frame of the new scene.

1 57. The at least one program storage device of claim
2 56, wherein said level of frequency data to be retained is
3 associated with a frequency constraining pattern, and said
4 determining comprises selecting a frequency constraining
5 pattern to be employed from a plurality of frequency
6 constraining patterns associated with said multiple
7 predefined levels.

1 58. The at least one program storage device of claim
2 57, wherein said plurality of frequency patterns comprise a
3 common geometrical shape, and wherein said common
4 geometrical shape of said plurality of frequency patterns
5 can be one of a plurality of common geometrical shapes.

1 59. The at least one program storage device of claim
2 57, wherein at least one most significant frequency pixel is
3 included by each of the plurality of frequency constraining
4 patterns.

1 60. The at least one program storage device of claim
2 55, wherein said dynamically determining comprises
3 determining said group of frequency domain pixel data to be
4 retained for said frame of the new scene by evaluating
5 picture difficulty of the new scene.

1 61. The at least one program storage device of claim
2 60, wherein said dynamically determining further comprises
3 ascertaining picture difficulty indicators representative of
4 picture difficulty of the new scene, wherein said picture
5 difficulty indicators are ascertained by computing pixel-to-
6 pixel differences in at least some of horizontal, vertical,
7 and diagonal directions.

1 62. The at least one program storage device of claim
2 61, wherein said picture difficulty indicators are
3 ascertained by computing pixel-to-pixel differences in each
4 of said horizontal, vertical, and diagonal directions.

1 63. The at least one program storage device of claim
2 61, wherein said ascertaining comprises determining a
3 maximum indicator for a frame picture of a progressive video
4 source or a field picture of an interlaced video source,
5 said maximum indicator being determined by comparing said
6 picture difficulty indicators to each other.

1 64. The at least one program storage device of claim
2 61, wherein said ascertaining comprises ascertaining picture
3 difficulty indicators in vertical and diagonal directions
4 for both top and bottom fields of a frame of an interlaced
5 video source, and picture difficulty indicators in vertical
6 and diagonal directions for the frame of the interlaced
7 video source, and wherein said ascertaining further
8 comprises ascertaining field-based indicators in vertical
9 and diagonal directions by computing a weighted summation of
10 individual top and bottom field indicators having a same
11 direction, and wherein for each vertical and diagonal
12 direction, a picture difficulty indicator is determined by
13 ascertaining a minium number between a corresponding field-
14 based indicator and a frame-based indicator derived from the
15 same frame of the interlaced video source.

1 65. The at least one program storage device of claim
2 64, wherein said ascertaining comprises selecting said
3 picture difficulty indicators by determining a maximum
4 indicator of the ascertained vertical and diagonal
5 indicators, as well as a horizontal indicator.

1 66. The at least one program storage device of claim
2 63, wherein said ascertaining further comprises mapping the
3 maximum indicator to a level of an n-level quantizer if the
4 value of the maximum indicator is between predefined
5 thresholds, and mapping the maximum indicator to a constant
6 number if the indicator is outside of said predefined
7 thresholds.

1 67. The at least one program storage device of claim
2 63, further comprising employing said mapping to identify an
3 address of a frequency pattern in a look-up table, said
4 look-up table containing a plurality of frequency patterns,
5 and wherein said determining comprises selecting one
6 frequency pattern of said plurality of frequency patterns.

1 68. The at least one program storage device of claim
2 67, wherein when the maximum indicator has a large nominal
3 value it is re-mapped into a frequency pattern comprising a
4 lesser number of frequency coefficients than a number of
5 coefficients of a frequency pattern corresponding to when
6 the maximum indicator has a smaller nominal value.

1 69. The at least one program storage device of claim
2 68, wherein said plurality of frequency patterns are indexed
3 such that a population of one frequency pattern is a subset
4 of a population of a frequency pattern with a lower index
5 number.

1 70. The at least one program storage device of claim
2 68, wherein said determining comprises comparing each
3 frequency coefficient of a block with respect to said
4 selected frequency pattern, and if the coefficient belongs
5 to the frequency pattern, the coefficient is retained as
6 part of said group of frequency domain pixel data.

1 71. The at least one program storage device of claim
2 55, wherein after a final frame count, if the actual frame
3 bits is smaller than the difference of a predefined number
4 and a guard band value, the difference is computed and a
5 number of zero bytes according to this difference is added
6 to the final picture count to ensure said pseudo-constant
7 bits per frame compressed signal.

1 72. The at least one program storage device of claim
2 55, wherein said method is implemented within an MPEG
3 encoder.

1 73. The at least one program storage device of claim
2 55, wherein said dynamically encoding further comprises
3 encoding said frame of the new scene as a intra-coded frame.

1 74. At least one program storage device readable by a
2 machine, tangibly embodying at least one program of
3 instructions executable by the machine to perform a method
4 of processing a sequence of video frames, said method
5 comprising:

6 dynamically encoding said sequence of video
7 frames, said dynamically encoding comprising:

8 encoding multiple blocks of a first frame of
9 the sequence of video frames in intra-coded mode
10 using a first orientation for said intra-coded
11 blocks; and

12 encoding multiple blocks of a second frame of
13 the sequence of video frames in intra-coded mode
14 using a second orientation for said intra-coded
15 blocks, wherein said first orientation and said
16 second orientation are perpendicular.

1 75. The at least one program storage device of claim
2 74, wherein said first orientation comprises a first
3 diagonal orientation, and said second orientation comprises
4 a second diagonal orientation.

1 76. The at least one program storage device of claim
2 75, wherein said first frame and said second frame comprise
3 adjacent frames in said sequence of video frames.

1 77. The at least one program storage device of claim
2 75, wherein said multiple intra-coded blocks of said first
3 frame are scattered throughout said first frame, and wherein
4 said multiple intra-coded blocks of said second frame are
5 scattered throughout said second frame.

1 78. The at least one program storage device of claim
2 75, wherein said multiple intra-coded blocks of said first
3 frame are equally spaced along a direction perpendicular to
4 said first orientation of said multiple intra-coded blocks,
5 and wherein said multiple intra-coded blocks of said second
6 frame are equally spaced along a direction perpendicular to
7 said second orientation of the multiple intra-coded blocks.

1 79. The at least one program storage device of claim
2 75, wherein said encoding said multiple blocks of said first
3 frame in intra-coded mode using said first orientation
4 comprises imposing different sub-sampling rates on said
5 multiple intra-coded blocks along said first orientation,
6 and wherein said encoding multiple blocks of said second
7 frame in intra-coded mode using said second orientation
8 comprises imposing different sub-sampling rates on said
9 multiple intra-coded blocks along said second orientation.

1 80. The at least one program storage device of claim
2 75, wherein said sequence of video frames comprises a
3 plurality of even numbered frames and a plurality of odd
4 numbered frames, and wherein said first frame comprises one
5 frame of said plurality of even numbered frames and said
6 second frame comprises one frame of said plurality of odd
7 numbered frames, and wherein intra-coded blocks of said
8 plurality of even numbered frames move along said first
9 orientation in a direction opposite from that of intra-coded
10 blocks moving along said second orientation within said
11 plurality of odd numbered frames.

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